

Aligning Innovation and Telecommunications Policy

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The challenge

- “[A]ny theory that purports to explain novelty, whether it deals with invention, innovation, or the emergence of new species of biota, is intrinsically difficult and paradoxical. How can you have a theory of the unexpected?” (Kenneth Arrow, 2012, p. 43)
- How can we design policy that supports the unexpected?

Overview

- Regulation and innovation
- Innovation as combinatorial process
- Drivers of innovation and policy levers
- Implications and takeaways

Growing interest in innovation

- Monopoly telecommunications
 - Technological change was welcomed and simplified balancing investor and consumer interests, but it was not designed into regulation
 - By the 1970s, the view was widely accepted that the incentives created by monopoly regulation slowed technological change and impeded innovation
- Competitive reforms and incentive regulation
 - Market liberalization was generally motivated by its beneficial effects on innovation in addition to the expected efficiency gains
 - Where continued regulation was needed, economic research focused on the design of efficiency-enhancing incentives and mechanisms (e.g., price caps)
- Digital ecosystems require new foundations
 - Proliferation of technologies (e.g., public and private internets, 5G, 6G, Wi-Fi, XR, AI, and space communications) requires a reassessment and renewal

Toward a dynamic view of innovation

- Innovation is commonly operationalized as the introduction of a new process, product, service, business model, or design
- It is better described as a process of combining and recombining knowledge into an “adjacent possible” (Kauffman, 1995)
- Innovation is an evolutionary search process (variation, selection, reproduction), a process of trial-and-error (Arthur, 2009)

Innovation in traditional IO research

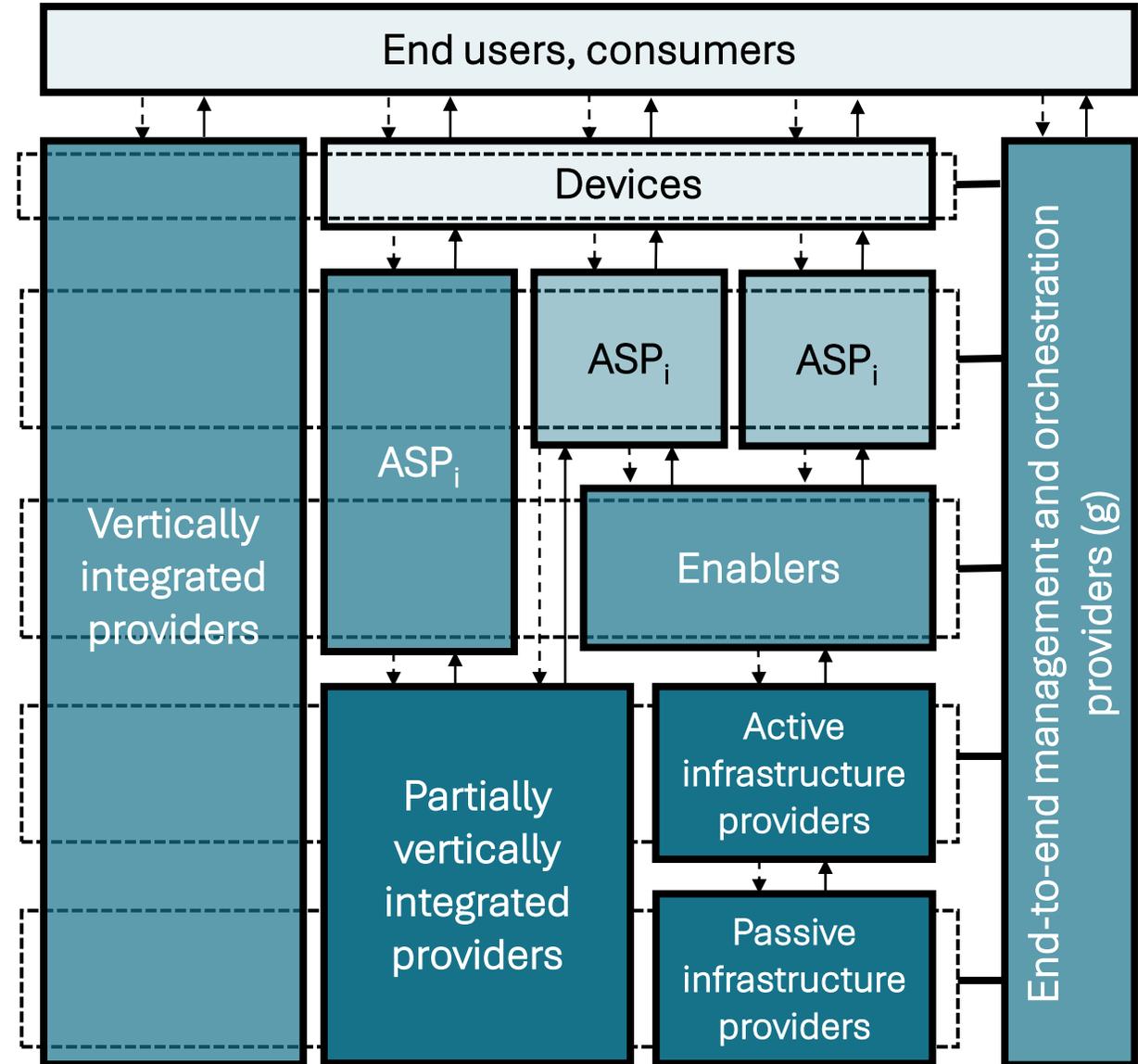
- Schumpeter's "gales of creative destruction" challenged the mainstream economic focus on static efficiency
- Market structure and innovation
 - Numerous empirical studies of whether monopoly or competition is more conducive to innovation (e.g., Kamien & Schwartz, 1982)
- Arrow vs. Schumpeter controversy (e.g., Shapiro, 2012)
 - Initiated a rigorous program to examine incentives to innovate for firms under (highly stylized) competitive and monopoly conditions
 - Modeled substitution and replacement effects on revenues and profits and showed that competition was more conducive to innovation
- Contrast static and dynamic efficiency (given or changing technology) in an equilibrium framework

Heterodox and managerial approaches

- View innovation as out-of-equilibrium process that cannot be modeled successfully which traditional theories of incremental optimization
- Evolutionary theories of economic change (Nelson & Winter, 1982; Dosi, 1988)
 - Recognize that innovation is a trial-and-error, a dynamic learning process under conditions of risk and uncertainty
 - Model innovation as a process of variation, selection (of successful variations, e.g., in the marketplace), and replication (scaling)
- Managerial economics and strategic management
 - Dynamic capabilities (e.g., Teece, 1992; Teece et al., 1997; Petit & Teece, 2021)
 - Business ecosystem competition and ambidextrous organizations (e.g., O'Reilly & Tushman, 2004; Williamson & De Mayer, 2012)

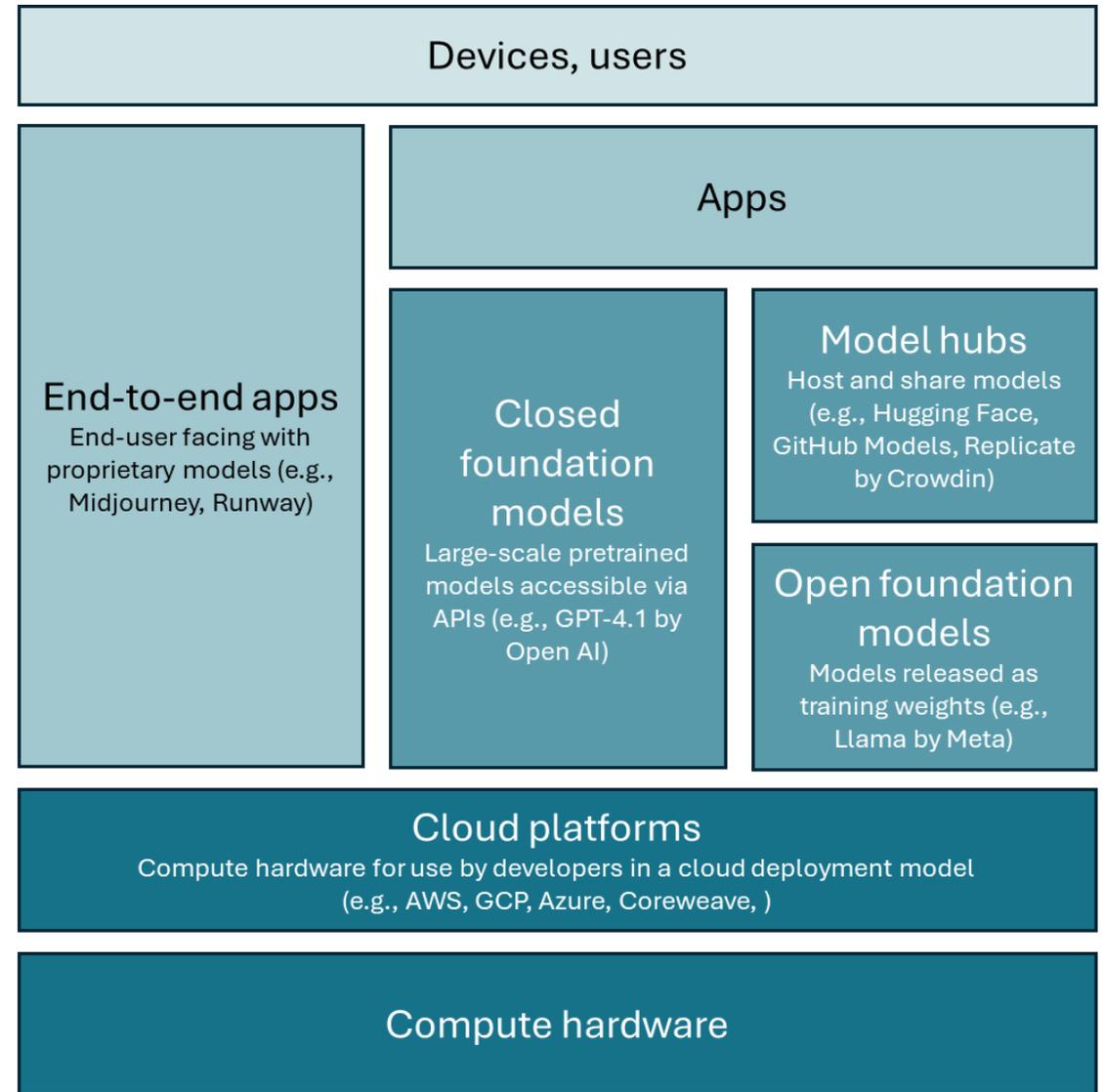
Innovation in the telecom ecosystem

- Radical innovations change many attributes of a process, product, service, etc. (e.g., Internet, LEOs, 6G)
- Incremental innovations (e.g., versions of Wi-Fi) change one or a few attributes
- Interdependent innovations
 - Integrated (tightly coupled)
 - Modular (weakly coupled)



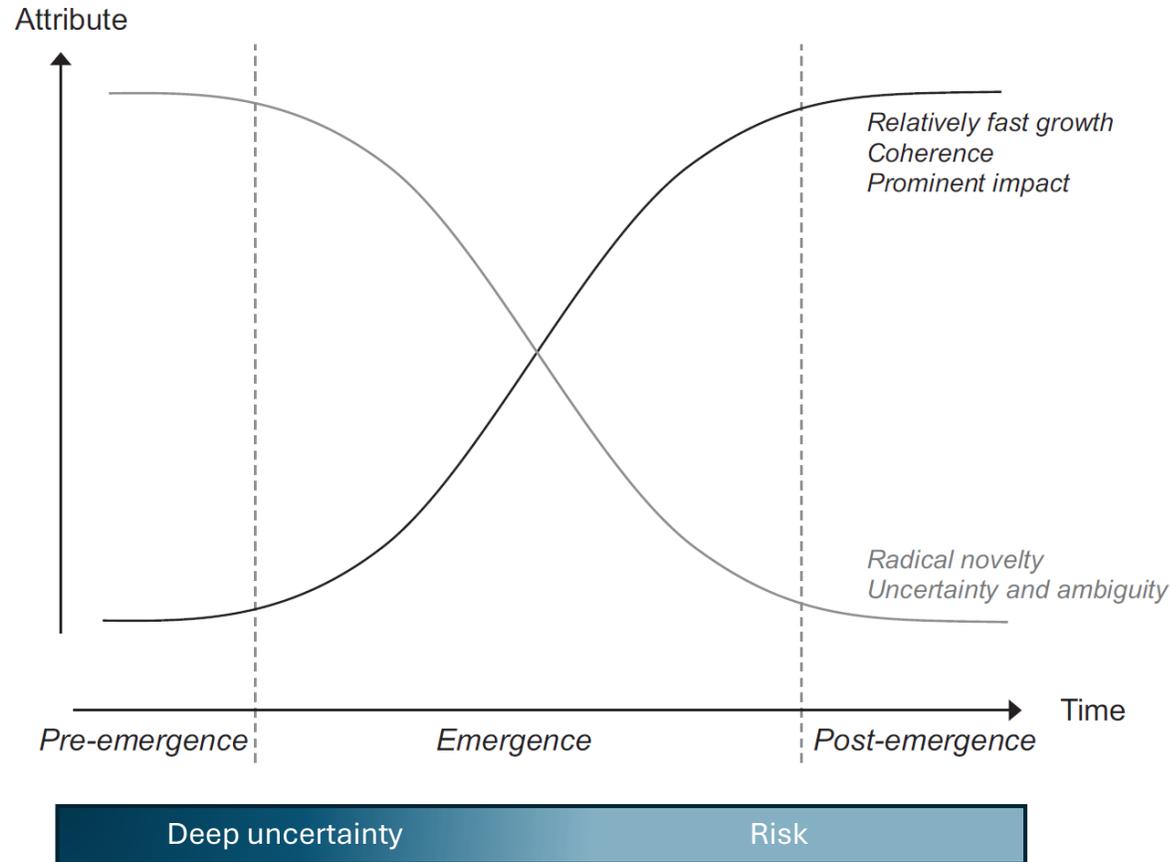
Innovation in the AI ecosystem

- Radical innovations change many attributes of a process, product, service, etc. (e.g., ChatGPT)
- Incremental innovations (e.g., versions of AI models) change one or a few attributes
- Interdependent innovations require coordination between players in the AI stack



Inspired by Andreessen Horowitz (2023), <https://a16z.com/who-owns-the-generative-ai-platform/>

Emerging and mature technologies

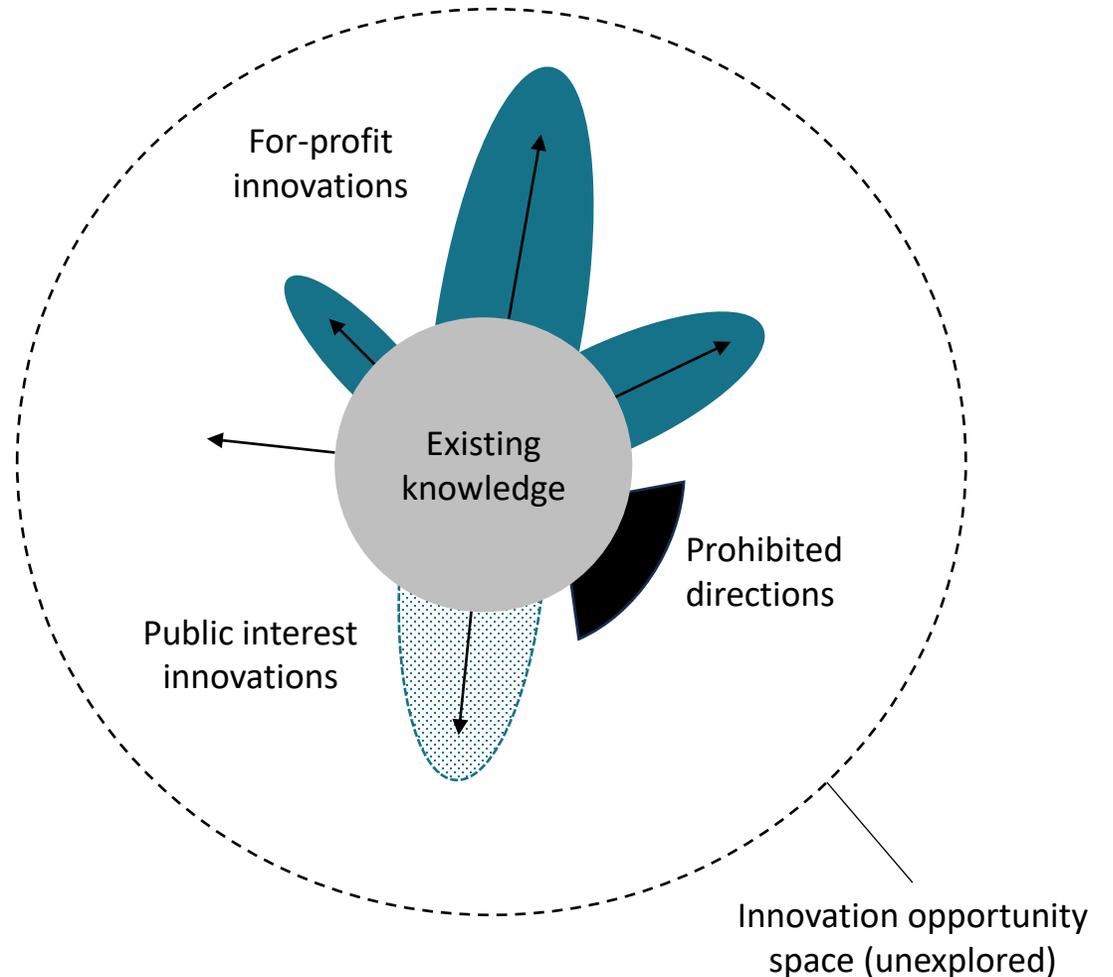


Source of illustration: Rotolo et al. (2015)

- Emerging technologies (Rotolo et al., 2015)
 - Radical novelty
 - Coherence
 - Relatively fast growth
 - Prominent impact
 - (Deep) Uncertainty
- Mature technologies follow a risky but more predictable path
- Coexistence result creates numerous, possibly wicked, policy challenges

Innovation as directed search

- Innovation efforts are directed explorations of the (technical, business, etc.) opportunity space
- Firms will explore different directions depending on their capabilities and strategies
- Competition will stimulate diverse searches, but it may fail to explore all socially beneficial directions
- Bans constrain the search space, often with unknown benefits, costs, effects



Varying drivers of innovation

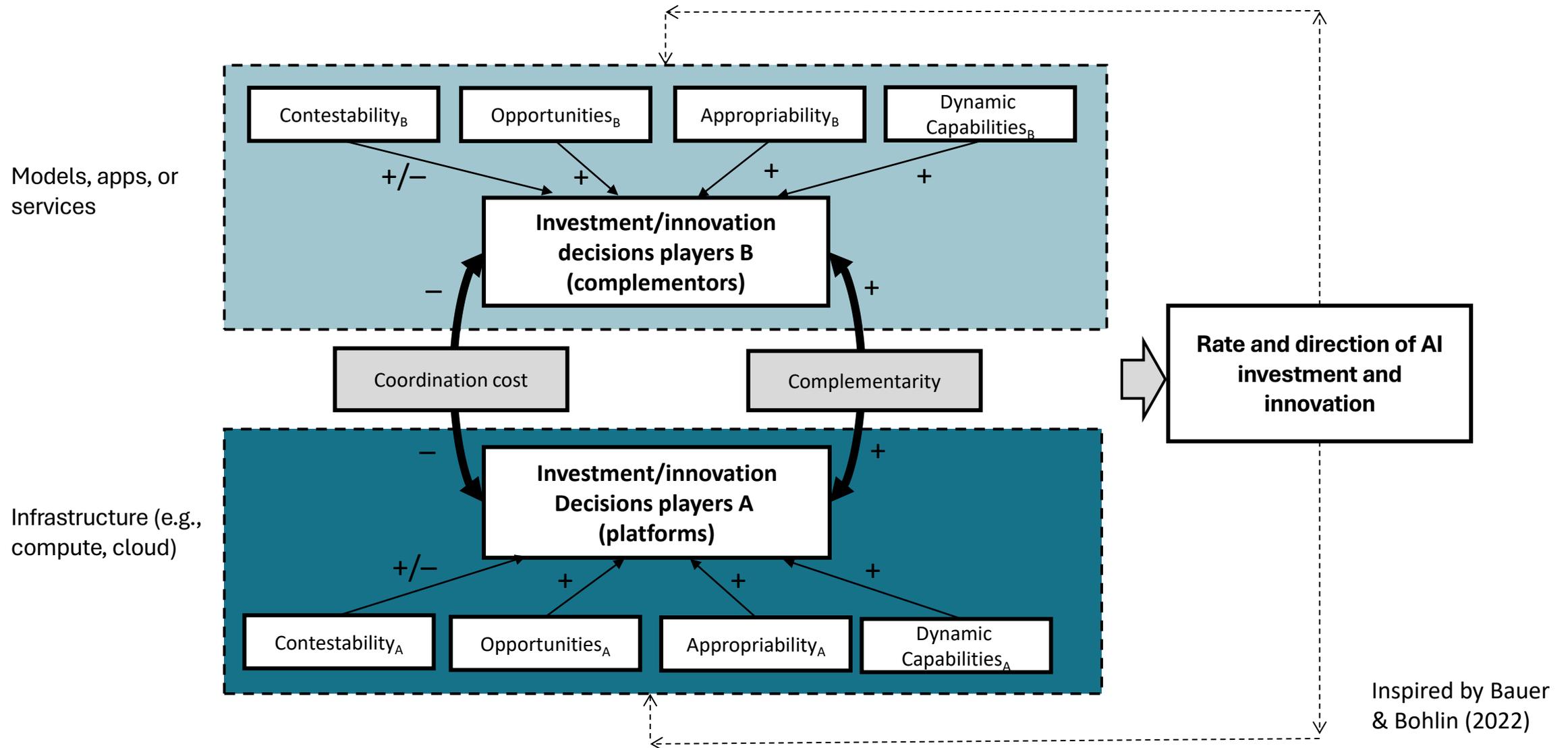
Pre- and early emergence

- Inventive tinkering and entrepreneurship (+)
- Dynamic capabilities (sensing, seizing, implementing) (+)
- Availability of risk capital and early-stage venture funding (+)
- (Publicly supported) foundational research (+)

Late and post-emergence

- Innovation opportunities
 - Technical (+)
 - Business (+)
 - Regulatory (+)
- Appropriability of innovation premiums (value, profits) (+)
- Contestability of the innovation space (+/-)

Interdependent innovation (two-layer model)



Translation into regulatory practice

- Step 1: Examine how a proposed policy measure (e.g., interoperability requirements, industrial policy) affects the innovation opportunities space of players and their ability to pursue innovation experiments
- Step 2: Examine how a proposed policy measure affects the main drivers of innovation (contestability, appropriability, dynamic capabilities, coordination costs, complementarities)
- Step 3: Examine how a proposed policy measure affects different players (as players in ecosystems are often differentially affected)
- Step 4: Explore whether alternative policy designs that have stronger upsides or fewer potential downsides are available
- Step 5: Design policy with agility in mind (provide for regular monitoring, evaluation, adaptation)

Overarching guiding principles

- Provide preconditions for digital ecosystem innovation
 - Remove obstacles that unnecessarily constrain the innovation opportunities search space
 - Policy programs that help explore directions for innovation that private firms only pursue at a sub-optimally low level
 - Sufficient access to complementary resources (e.g., electromagnetic spectrum, rights of way)
- Measures to facilitate telecom innovation
 - Safeguard contestability to prevent dominant players from closing their systems in ways that handicap complementors (e.g., Hagiu & Wright, 2025)
 - Allow vertical integration and adopt measures that reduce coordination costs in for modular innovations (e.g., standardization, licensing frameworks)
- Use guardrails and leashes only if there are clear and compelling reasons

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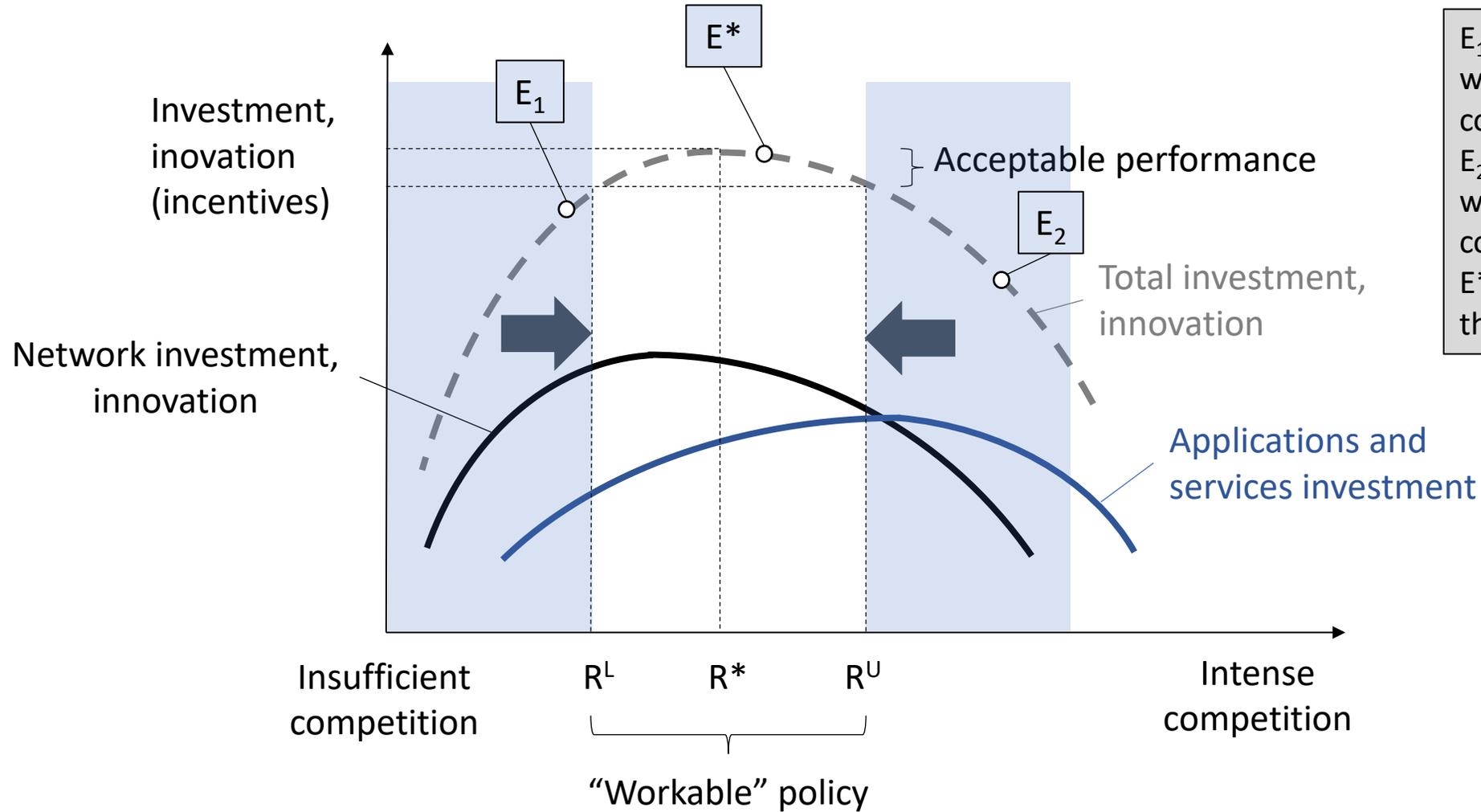
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Finding the zone of workable policy



E_1 ... policy regime with too little competition (US)
 E_2 ... policy regime with too much competition (EU)
 E^* ... policy regime in the workable zone

Effects of selected policy instruments

	Prohibitions	Non-discrimination	Standards	Competition policy	Industrial policy
Innovation opportunities/efforts	-	+/-	+/-	+	+
Safeguarding contestability	-/+	+/-	-	+	~
Dynamic firm capabilities	-	-	+/-	+	+
Reduction of coordination costs	~	+/-	+	~	~
Strengthening of complementarity	-/+	+/-	+	~	~

Notes: + ... feasible and effective; - ... not feasible or not effective; ~ ... has role to play, effectiveness not known; ? ... not known.